DPD | Director's Rule 27-2005

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Subject: Standard Design for Energy Code Analysis for Nonresidential Buildings	**Code and Section Reference:** Seattle Energy Code, Reference Standard 29 (RS-29)	
	Type of Rule: Code Interpretation	
	Ordinance Authority: SMC 3.06.040	
Index: Energy – Systems Analysis Procedural Requirements	**Approved** **Date** (signature on file) 9/23/05 Diane M. Sugimura, Director, DPD	

The Energy Code (Washington State Energy Code with Seattle amendments) allows compliance to be demonstrated through the systems analysis requirements of Reference Standard 29 (RS-29) for other than Group R occupancy. The purpose of this rule is to define the base case (Standard Design) for systems analysis and to define the procedural requirements for review of this base case. The estimated energy usage of the proposed project (Proposed Design) shall then be compared against this base case.

For other than Group R occupancy, Section 2.1 of Energy Code RS-29 states in part as follows:

> "For a proposed building design to be considered similar to a "Standard Design," it shall utilize the same energy source(s) for the same function and have equal floor area and the same ratio of envelope area to floor area, environmental requirements, occupancy, climate data and usage operational schedule. Inputs to the energy analysis relating to occupancy and usage shall correspond to the expected occupancy and usage of the building.

Except as noted below, the systems identified, and, to the extent possible, the assumptions made in assigning energy inputs to each system, shall be the same for the Standard Design and the Proposed Design."

A. RULE

Building permit applications submitted using the Energy Code systems analysis option shall comply with this rule.

1. GENERAL PRINCIPLES

Unless otherwise approved by Seattle DPD, the following general principles shall be followed in the determination, analysis and review of the Standard Design:

- Analysis shall be performed using a program which
  - is listed in Section 4 of RS-29 for other than Group R occupancy as being acceptable,
  - uses a full year of weather data as available and as suitable for that program, and
  - is capable of modeling strategies to be used in the proposed building;
- To the extent possible, the specifications of the Standard Design shall be equivalent to the requirements in RS-29 of the Energy Code and as stated herein;
- The specifications of the Proposed Design used in the analysis shall be as similar as is reasonably practical to those in the plans submitted for a building permit;
- The Proposed Design shall comply with Sections
  - 1310 through 1314,
  - 1410 through 1416,
  - 1440 through 1443,
  - 1450 through 1454, and
  - 1510 through 1513.

  The Proposed Design shall only vary from those requirements in Sections
  - 1330 through 1334,
  - 1430 through 1439, and
  - 1530 through 1532

  where those variations have been accurately and completely modeled. Where variations are not specifically analyzed, the Proposed Design shall comply with these requirements.
- Where the Energy Code does not contain requirements, the specifications and operations of the Standard Design and of the Proposed Design shall be identical and as stated herein;
- The Standard Design shall not have a greater number of hours of loads-not-met, i.e. a lower level of comfort, than the Proposed Design, unless both have equipment sized at 100% or more of the load at design conditions. Where the Proposed Design equipment is sized at less than 100% of the design load, the Standard Design equipment size shall be reduced so that there are a comparable number of hours of loads-not-met; and

- Where assumptions are not listed herein, the values shall be based on accepted engineering practice and are subject to the review and approval of Seattle DPD.

2. PROCEDURAL REQUIREMENTS

Preliminary Meeting Prior to Starting the Energy Analysis

While there is no requirement to do so, the design team is strongly encouraged to contact the Seattle Department of Planning and Development (DPD) prior to starting any systems analysis. Coming to early understandings about how to handle shading by adjacent buildings, zoning the building, mechanical system types and other assumptions for the Standard Design, etc. will simplify the process and provide greater certainty to all.

The applicant should contact the Energy/Mechanical Plans Review Section to arrange a meeting with representatives of the design team, Seattle DPD, and Seattle City Light. Prior to the meeting, the applicant should review the systems analysis requirements to identify any questions that they might have.

The applicant should bring the following information and materials to the meeting:

- A summary of the project that includes:
  - the number of stories (above and below grade),
  - typical floor size,
  - the uses in the building (e. g. office, cafeteria, retail, parking, etc.),
  - the gross square footage of each use, and
  - whether each use is conditioned space.
- A site plan showing all adjacent buildings and topography which may shade the proposed building (with estimated height or number of stories).
- Building elevations (schematic is okay).
- Building floor plans (schematic is okay).
- DPD building pre-design project number (if a building pre-design conference has been held).

The applicant should be prepared to discuss:

- The reason for using the systems analysis compliance option (i.e. what elements of the proposed design do not comply with the Energy Code).
- A list of proposed energy efficiency strategies being considered to compensate for those elements that do not comply with the Energy Code.
- The energy analysis program proposed to be used, including confirmation that the program selected is capable of modeling the energy efficiency strategies in the Proposed Design.
- General information about how the Proposed Design compares with the Energy Code requirements, such as glazing percentage, glazing U-factor and SHGC, whether the glazing is

set back or shaded by overhangs, insulation levels, HVAC system type, economizer percentage, and equipment efficiencies.

- General information on the various other energy end uses in the project, internal loads, occupancy schedules, etc.
- A proposal for which adjacent buildings and topography are to be included in the energy analysis because they shade the proposed project, and how that shading is to be modeled.
- A proposal for how the shading from overhangs or glazing setbacks is to be modeled.
- A proposal for zoning of the building for modeling the HVAC system.
- Proposals for modeling any unusual elements (e.g. heat flow through below grade walls, food preparation and kitchen hood exhausts in cafeterias and restaurants, internal loads from refrigeration equipment in supermarkets, etc.).
- Schedule for performing the energy analysis.
- Schedule for permit application, and information on which components (building, mechanical, lighting) will be included in the permit application.

(Note that Section 1.1 of RS-29 requires that:

"The building permit application for projects utilizing this Standard shall include in one submittal all building and mechanical drawings and all information necessary to verify that the design for the project corresponds with the annual energy analysis. If credit is proposed to be taken for lighting energy savings, then electrical drawings shall also be included with the building permit application."

Consequently, mechanical system improvements can not be used to offset shortfalls in the building envelope, unless the mechanical drawings are included in the building permit application. Also, no credit can be taken for lighting system improvements unless the lighting drawings are included in the building permit application.)

Submittal and Review of the Completed Energy Analysis

Three copies of a report summarizing and explaining the systems analysis shall be submitted. The report shall follow the format in Appendix A and include:

- an executive summary which provides a brief description of the project and the outcome of the energy analysis,
- a listing of the elements of the proposed design that do not comply with the Energy Code as well as those energy efficiency measures being used to compensate,
- an explanation of any unusual modeling assumptions,
- a summary by end use of the energy savings in the Proposed Design (from largest to smallest) and an explanation of
  - what energy efficiency measures are responsible for these energy savings, and
  - whether these savings are reasonable given the energy efficiency measures,

- a completed copy of the numerical summary of the results of the systems analysis using the form provided in Appendix A,
- back-up calculations and material to support data inputs,
- pertinent documentation of the efficiency improvements proposed, and
- the complete computer inputs and outputs for both the Standard Design and the Proposed Design.

All pages shall be numbered (including the inputs and outputs).

If desired, the applicant may submit the analysis prior to the building permit application for one initial round of review. To be most useful for the applicant, this energy analysis submittal should be as complete as possible – ideally containing all of the material listed above. Initial review is generally limited to a comparison between the Standard Design and the Proposed Design. Prior to building permit application, it is not possible to compare the Proposed Design with the drawings. Consequently, there may be additional issues regarding the modeling of the Proposed Design that arise later when the building permit application is reviewed. Be aware that, if the modeling of the Proposed Design is inconsistent with the drawings, it may also be necessary to revise the Standard Design as many of the Standard Design parameters correlate with the Proposed Design.

As appropriate, revised analysis should be submitted at the time of, or soon after, building permit application. **This analysis must correspond with the plans in the building permit application (surface areas of the building, uses within the building, efficiencies and CFM for proposed equipment, etc.) Submittal of analysis which has not been updated from the preliminary design will likely result in a lengthier correction list.** As the plans are not routed for energy review first, energy analysis submitted within two weeks of building permit application is usually timely enough so as to not delay the review. Both the architectural and mechanical plans shall be submitted (if credit is to be taken for mechanical system improvements). The energy design will not be approved and permits will not be issued for construction until the energy analysis is compared with the architectural and mechanical drawings. A delay in submitting the energy analysis or the architectural or the mechanical drawings will delay the review and issuance of permits. If a preliminary analysis is not submitted, the analysis must be submitted <u>with</u> the building permit application.

3. REQUIRED ASSUMPTIONS FOR THE STANDARD DESIGN AND PROPOSED DESIGN BUILDINGS (Numbers in parentheses are Energy Code section references.)

	Standard Design	Proposed Design
1. EXTERIOR CONDITIONS		
A. Hourly air temperature, solar radiation, wind and humidity (RS-29, 2.4):	same as Proposed Design	Use values from weather files for approved analysis programs
B. Shading by adjacent structures and terrain (RS-29, 3.3.5):	same as Proposed Design	The effect which structures and significant vegetation or topographical features have on the amount of solar radiation being received by a structure shall be adequately reflected in the computer analysis. In general, all elements whose effective height is greater than their distance from a proposed building shall be account for in the analysis. If the computer program has a subroutine to simulate shading by adjacent structures, then this option shall be used. If the computer program does not have a subroutine to simulate shading by adjacent structures, then any portion of a structure which is shaded most of the time may be modeled as having a north-facing orientation.
C. Ground reflectivity (RS-29, 3.3.3):	same as Proposed Design	To match building site, typically 20% (but may vary due to reflections from water, etc.)
D. Ground temperatures for below-grade wall and basement floor heat loss calculations:	same as Proposed Design	It is acceptable to use an annual average ground temperature for calculation of heat loss through below-grade walls and basement floors, 53ºF is recommended. If monthly temperatures are desired, the following values are recommended: J-49, F-48, M-49, A-51, M-53, J-55, J-57, A-58, S-57, O-55, N-53, D-51.
E. Water main temperatures (based on 14-year average from Seattle Water Dept.):	same as Proposed Design	It is acceptable to use an annual water main supply temperature, 53ºF is recommended. If monthly temperatures are desired, the following values are recommended: J-44, F-44, M-46, A-51, M-56, J-61, J-65, A-66, S-59, O-50, N-49, D-45.

	Standard Design	Proposed Design
2. DESIGN REQUIREMENTS		
A. Exterior Design conditions (1431.2)		
- Winter:	same as Proposed Design	24ºF dry bulb
- Summer:	same as Proposed Design	82ºF dry bulb/66ºF wet bulb
B. Interior Design conditions (1431.2)		
- Heating:	same as Proposed Design	70ºF
- Cooling:	same as Proposed Design	75ºF
		unless special design conditions justify other values
C. Outside air (1402):	same as Proposed Design	per Seattle Mechanical Code Chapter 4. It is acceptable to use % of system cfm or other basis for inputs provided the minimum requirements are met. (Note that the occupancy densities for the annual energy analysis are less than those used for design.)
D. People (RS-29, 3.2.1)		
- Density for modeling purposes:	same as Proposed Design	per RS-29, Table 3-1, for analysis, unless other values are justified
- Schedule:	same as Proposed Design	to match expected occupancy (or use schedules in RS-29 Table 3-2 if exact schedule is not known)
- Internal load contribution:	same as Proposed Design	230 sensible/190 latent Btuh (RS-29, Table 3-1) unless other values are justified
E. Other internal load densities and schedules (RS-29, 3.2):	same as Proposed Design (RS-29, 3.4.2)	to match expected occupancy and usage (see more detailed comments below for each end use)
F. HVAC zoning for modeling purposes (RS-29, 3.4.1):	same as Proposed Design	At a minimum, - each different occupancy in each building shall be modeled with a separate set of zones, and - each occupancy shall have a minimum of four perimeter and one interior zone per floor. Generally, the perimeter zones shall be 15 feet in width. Rooms which differ greatly in usage (e.g. kitchen with high internal loads vs. storage area with low internal loads) typically need to be described in separate zones. All rooms which are included in a zone should have similar internal loads. Rooms which have different temperature control strategies (e.g. hospital office area with daytime use

	Standard Design	Proposed Design
		only vs. hospital patient rooms with 24-hour occupancy) typically need to be described in separate zones. A zone can only have one control profile, so all rooms which are included in a zone will be controlled the same way. Rooms which have greatly differing solar gains should not be included in the same zone, because the effects of the solar loads will be diluted throughout the entire zone.
3. BUILDING ENVELOPE		
A. Overhead glazing		
- General (for conditioned space):	requirements vary by space heat system type	
- Electric resistance space heat (1302):	area = per Equation 13-1 (same as Proposed Design, but overhead glazing not to exceed 30% of the gross wall area)	to match drawings
	U=0.48	to match drawings
	SHGC=0.40	to match drawings
- All other space heat including heat pumps and VAV (1302):	area = per Equation 13-1 (same as Proposed Design, but overhead glazing not to exceed 45% of the gross wall area)	to match drawings
	U-factor = based on glazing area in Proposed Design (U=0.54 if total vertical plus overhead glazing area is over 45%, otherwise per Table 13-1)	to match drawings
	SHGC=0.40	to match drawings
B. Vertical glazing		
- General (for conditioned space):	glazing distribution = same as the Proposed Design or equal percentage of the gross wall area on all sides of the building (RS-29, 3.3.1)	to match drawings
	glazing flush to wall surface with no shading by overhangs, fins, mullions, etc. OR same as Proposed Design	to match drawings, except that overhangs and setbacks less than 6 inches need not be modeled
	no draperies or blinds (RS-29, 3.3.4)	same as Standard Design
- Electric resistance space heat (1302):	area = per Equation 13-1 (same as Proposed Design, but sum of overhead glazing plus vertical glazing not to exceed 30% of the gross wall area)	to match drawings
	U=0.40	to match drawings
	SHGC=0.40	to match drawings
- All other space heat including heat pumps and VAV (1302):	area = per Equation 13-1 (same as Proposed Design, but sum of overhead glazing plus vertical glazing not to exceed 45% of	to match drawings

	Standard Design	Proposed Design
	the gross wall area)	
	U-factor = based on glazing area in Proposed Design (U=0.45 if total vertical plus overhead glazing area is over 45%, otherwise per Table 13-1)	to match drawings
	SHGC=0.40	to match drawings
C. Roof (opaque)		
- General (for conditioned space):	area = per Equation 13-1 (gross roof area minus Target overhead glazing area)	to match drawings
- Electric resistance space heat (1302):	roof over attic U=0.031	to match drawings
	all other roofs U=0.034	to match drawings
- All other space heat including heat pumps and VAV (1302):	roof over attic U=0.036	to match drawings
	all other roofs U=0.046	to match drawings
D. Wall (opaque)		
- General (for conditioned space):	area = per Equation 13-1 (gross wall area minus Target vertical glazing area minus opaque door area)	to match drawings
	If calculations submitted documenting adequate heat capacity, masonry wall U-factor allowed to comply with Table 13-1 Footnote 2	to match drawings
	Below-grade walls to comply with U-factors from the component performance approach in Table 13-1 Footnote 1)	to match drawings
- Electric resistance space heat (1302):	all other walls U=0.062	to match drawings
- All other space heat including heat pumps and VAV (1302):	metal framed walls U=0.084	to match drawings
	all other walls U=0.062	to match drawings
	(except same as proposed for semi-heated spaces)	to match drawings
E. Doors (opaque)		
- General (for conditioned space):	area = per Equation 13-1 (same as Proposed Design) Note that glass doors are included in glazing.	to match drawings
- Electric resistance space heat (1302):	U=0.60	to match drawings
- All other space heat including heat pumps and VAV (1302):	U=0.60	to match drawings
F. Floor over unconditioned space		
- General (for conditioned space):	area = per Equation 13-1 (same as Proposed Design)	to match drawings
- Electric resistance space heat (1302):	U=0.029	to match drawings
- All other space heat	U=0.056	to match drawings

	Standard Design	Proposed Design
including heat pumps and VAV (1302):		
F. Slab on grade floor		
- General (for conditioned space):	perimeter = per Equation 13-1 (same as Proposed Design)	to match drawings
- Electric resistance space heat (1302):	F=0.54 (F=0.55 for radiant slabs)	to match drawings
- All other space heat including heat pumps and VAV (1302):	F=0.54 (F=0.55 for radiant slabs)	to match drawings
G. Interior partitions	same as Proposed Design	to match drawings
H. Heat capacity	same as Proposed Design	to match drawings
I. Infiltration	same as Proposed Design	to match drawings, no infiltration when building fan system is on
4. LIGHTING - INTERIOR		
A. Installed wattage:	per Section 1531 and Table 15-1 PLUS same exempt lighting as in Proposed Design (particularly important for retail)	to match drawings (or same as Standard Design if not in this permit)
B. Controls:	same as Proposed Design (including automatic lighting controls)	to match drawings (and drawings to include requirements in 1513 such as automatic controls, occupancy sensors, and daylight dimming)
C. Schedule:	same as Proposed Design (including automatic lighting controls)	to match expected usage including - 24-hour emergency lighting at 5%, - after-hours maintenance, and - automatic controls (or use schedules in RS-29 Table 3-2 if exact schedule is not known)
D. Internal load contribution:	same as Proposed Design	to match drawings
E. Commissioning:	same as Proposed Design	to match drawings (and drawings to include requirements in 1513.7)
5. LIGHTING – PARKING AND OTHER LIGHTED OUTDOOR AREAS		
A. Installed wattage:	per Section 1532 PLUS same exempt lighting as in Proposed Design	to match drawings (or same as Standard Design if not in this permit)
B. Controls:	same as Proposed Design (including automatic lighting controls)	to match drawings (and drawings to include requirements in 1513 such as automatic controls)
C. Schedule:	same as Proposed Design	to match expected usage, typically

	Standard Design	Proposed Design
	(including automatic lighting controls)	- 24 hrs/day for interior garage - 12 hrs/day for exterior
D. Internal load contribution:	same as Proposed Design	none
6. LIGHTING – FAÇADE		
A. Installed wattage:	per Section 1532: - 0.15 W/SF of façade or - 7.5 W/lineal foot of perimeter	to match drawings (or same as Standard Design if not in this permit)
B. Controls:	same as Proposed Design (including automatic lighting controls)	to match drawings (and drawings to include requirements in 1513)
C. Schedule:	same as Proposed Design (including automatic lighting controls)	to match expected usage, typically - 12 hrs/day for exterior
D. Internal load contribution:	same as Proposed Design	none
7. SPACE HEATING AND SPACE COOLING		
A. System type:	same as Proposed Design (RS-29, 3.4) (except modified as necessary to comply with the Energy Code) OR prototype HVAC system (RS-29, 3.4, exception)	to match drawings
B. Economizer cycle:	100% air economizer subject to the limits of Section 1433	to match drawings (and drawings to include requirements in 1413)
C. Equipment type:	reciprocating chiller for chilled water systems with total cooling capacities less than 175 tons, and centrifugal chillers for systems with total cooling capacities of 175 tons or greater; a minimum of two centrifugal chillers lead/lag controlled for systems with cooling capacities of 600 tons or greater (RS-29, 3.4.3)	to match drawings (and drawings to match requirements in 1411.4)
D. Equipment efficiency:	per Tables 14-1A to 14-1M for most equipment, per Table 14-4 for motors, and per 1411.3 for combination space and service water heating equipment	to match drawings (but not less than the minimums specified in 1411)
E. Controls:	same as Proposed Design	to match drawings (and drawings to include requirements in 1412 such as 7-day clock, optimum start, and other)
F. Waste energy recovery:	per Section 1436	to match drawings
G. Heating & cooling system size:	equipment size based on the same or lesser ratio of installed system capacity to design load for heating and cooling as the Proposed Design	to match drawings, autosizing by the simulation tool is <u>not</u> allowed (RS-29, 3.4.3)

	Standard Design	Proposed Design
	(RS-29, 3.4.3) equal or greater number of hours of loads-not-met within all major zones as compared with the Proposed Design	
H. Commissioning:	same as Proposed Design	to match drawings (and drawings to include requirements in 1416)
8. VENTILATION – INTERIOR		
A. System type:	same as Proposed Design (RS-29, 3.4) (except modified as necessary to comply with the Energy Code)	to match drawings
B. Air flow capacity (CFM):	use same sizing method as Proposed Design (i.e. same static pressure, same supply air delta T, etc.)	to match drawings (RS-29, 3.4.3)
C. Motor efficiency:	per Table 14-4 for motors covered by that table, per 1437 for fans in series terminal units, same as Proposed Design for other motors (where motor efficiency not specified, use the values in Table 3A, p.30.7 of the 2005 ASHRAE Fundamentals Handbook)	to match drawings
D. System Watts/CFM:	same as the Proposed Design (RS-29, 3.4.4)	to match drawings
E. Variable frequency drive:	variable frequency drive (RS-29, 3.4.4)	to match drawings
F. Cooling tower:	cooling towers with total fan motor HP greater than 10 HP to be equipped with a variable speed drive or with a pony motor of a rated horsepower no greater than 1/3 of the horsepower of the primary motor (1438.1)	to match drawings
G. Commissioning:	same as Proposed Design	to match drawings (and drawings to include requirements in 1416)
9. VENTILATION – TOILET AND OTHER EXHAUST		
A. Installed capacity (CFM and wattage):	same as Proposed Design	to match drawings and to provide the CFM required by the Seattle Mechanical Code
B. Controls	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage
D. Internal load contribution:	same as Proposed Design	none or an appropriate percent

	Standard Design	Proposed Design
10. VENTILATION – PARKING GARAGE		
A. Installed capacity (CFM and wattage):	same as Proposed Design	to match drawings and to provide the CFM required by the Seattle Mechanical Code
B. Controls	same as Proposed Design	to match drawings (and drawings to include requirements in 1412.8 such as automatic CO or timeclock control)
C. Schedule:	same as Proposed Design	to match expected usage, including automatic CO or timeclock controls per 1412.8
D. Internal load contribution:	same as Proposed Design	none
11. SERVICE WATER HEATING		
A. Installed capacity (gallons and BTU/Watts):	same as Proposed Design (or per ASHRAE Handbook, 2003 HVAC Applications Volume, if Proposed Design is not included in this permit)	to match drawings (or same as Standard Design if not in this permit)
B. Controls	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage (or use schedules in RS-29 Table 3-2 if exact schedule is not known) and combine with installed capacity to achieve use per RS-29, Table 3-1, for analysis, unless other values are justified (RS-29, 3.5)
D. Internal load contribution:	same as Proposed Design	none or an appropriate percent
E. Equipment efficiency:	same as Proposed Design (or per Tables 14-1A to 14-1M for most equipment and per 1411.3 for combination space and service water heating equipment, if equipment is listed in those tables)	to match drawings (but not less than the minimums specified in 1411)
F. Waste energy recovery:	none	to match drawings
12. ELEVATOR/ESCALATOR		
A. Capacity:	same as Proposed Design	to match drawings
B. Controls:	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage (or use schedules in RS-29 Table 3-2 if exact schedule is not known)
D. Internal Load	same as Proposed Design	none or an appropriate percent

	Standard Design	Proposed Design
Contribution:		
E. Equipment efficiency:	same as Proposed Design	to match drawings
F. Waste energy recovery:	none	to match drawings
13. OFFICE EQUIPMENT/ APPLIANCES		
A. Capacity (W/SF):	same as Proposed Design	per RS-29, Table 3-1, for analysis, unless other values are justified
B. Controls:	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage (or use schedules in RS-29 Table 3-2 if exact schedule is not known)
D. Internal Load Contribution:	same as Proposed Design	100% or an appropriate percent
E. Equipment efficiency:	same as Proposed Design	to match drawings
F. Waste energy recovery:	none	to match drawings
14. REFRIGERATION		
A. Capacity (W/SF):	same as Proposed Design	to match drawings
B. Controls:	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage (or, if appropriate, use schedules in RS-29 Table 3-2 if exact schedule is not known)
D. Internal Load Contribution:	same as Proposed Design	an appropriate percent per manufacturer's recommendations on spillover and usage
E. Equipment efficiency:	same as Proposed Design	to match drawings
F. Waste energy recovery:	none	to match drawings
15. COOKING		
A. Capacity (W/SF):	same as Proposed Design	to match drawings
B. Controls:	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage (or, if appropriate, use schedules in RS-29 Table 3-2 if exact schedule is not known)
D. Internal Load Contribution:	same as Proposed Design	an appropriate percent per manufacturer's recommendations
E. Equipment efficiency:	same as Proposed Design	to match drawings
F. Waste energy recovery:	none	to match drawings

	Standard Design	**Proposed Design**
16. OTHER		
A. Capacity:	same as Proposed Design	to match drawings
B. Controls:	same as Proposed Design	to match drawings
C. Schedule:	same as Proposed Design	to match expected usage (or, if appropriate, use schedules in RS-29 Table 3-2 if exact schedule is not known)
D. Internal Load Contribution:	same as Proposed Design	an appropriate percent
E. Equipment efficiency:	same as Proposed Design	to match drawings
F. Waste energy recovery:	none	to match drawings

This appendix is not part of this rule and is subject to change.

APPENDIX A
Reporting Format
(including Summary Forms)

The reporting format has been developed to guide both City staff and applicants through the energy analysis process. The report (three copies are to be submitted) begins with a text summary including project description, methodology description, and a discussion of the estimated energy consumption differences. These are accompanied by an appendix which has summary forms, calculations to support the inputs, and copies of the computer inputs and outputs (all with numbered pages).

The text and summary forms are among the most important parts of the submittal. This information is read prior to any review of the computer inputs and outputs to give an overall orientation to the project. The first evaluation of the project is based on a review of the text and summary forms. These indicate what the key energy-efficiency strategies are and form the basis for a more-detailed review of the drawings and of the computer analysis. Information for statistical summaries or other evaluations is drawn from the text and summary forms. While these may be the last items completed by the applicant prior to submittal, the importance of having them complete and accurate cannot be overemphasized.

REPORTING FORMAT OUTLINE

I. Executive Summary

II. Project Description

III. Methodology Description

IV. Discussion of Estimated Energy Consumption Differences

Appendices (Supporting Material)

- A. Energy Analysis Summary Form
  1. Energy Consumption by End use portion
  2. Design Parameter Comparison portion
- B. General Information
  1. Site Plan
  2. HVAC Zoning Diagram
- C. Building Envelope
  1. Fenestration: NFRC Certification Authorization Report (CAR) or Simulation Report for U-factor and SHGC or Manufacturer's Specifications for Shading Coefficient
  2. Opaque Elements: Cross-sections and U-factor Calculations
  3. Shading Diagrams
- D. Lighting System
  1. Lighting for Interior
  2. Lighting for Parking and Outdoor Areas
  3. Lighting for Façade
- E. Space Heating and Space Cooling
  1. Equipment Efficiency – Manufacturer's Specifications
- F. Ventilation
- G. Interior Exhaust Fans
- H. Parking Ventilation Fans
- I. Service Water Heating
- J. Other End uses
  1. Office Equipment
  2. Elevators and Escalators
  3. Refrigeration
  4. Cooking
  5. Other
- K. Computer Printout of Inputs and Outputs

I. Executive Summary

The executive summary is the condensed version of the text. This is usually several paragraphs long, never more than one page, and includes:

1. A brief description of the project with name, address, number of stories, and total square footage, as well as a listing of the various uses and the square footage of each use.
2. An explanation about why the systems analysis compliance option was chosen (i.e. what elements of the Proposed Design do not comply with the Energy Code).
3. A listing of the key energy efficiency features which are being used to compensate for the elements that do not comply.
4. The total energy consumption on a BTU-per-conditioned-square-foot-per-year basis for both the Standard Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Design (i.e. what the energy efficiency improvement has been).

II. Project Description

The project description is a detailed summary of the project. First is the name and the street address as well as adjacent cross-streets or streets on all four sides of the building if it is a full-block development. Indicate the number of stories and total square footage. A listing of the various uses and square footage of each use should be done on a floor-by-floor or a system-by-system basis. Thus, for mixed-use floors, specify how much is office and how much is retail, or how much is office and how much is lab. Include parking garage number of floors and area in the listing.

The description should also include information on the energy efficiency of the Proposed Design systems.

1. For the building envelope: indicate the glazing area, and how the fenestration U-factor and SHGC compare with the Standard Design requirements; and point out any opaque component U-factors or R-values which are better than the Standard Design requirements.
2. For each HVAC system: provide an explanation of the system including area served, key features, economizer percentage, control strategies, etc. Indicate any differences between the Standard Design and the Proposed Design, such as equipment efficiency.
3. For the lighting: indicate whether any tradeoffs are included in this analysis, and, if so, what they are.
4. For other end uses: indicate any differences between the Standard Design and the Proposed Design.

It is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

III. Methodology Description

The methodology description is an explanation of any aspects of the modeling which are unusual or not perfectly clear. (The algorithms in approved analysis programs are generally acceptable and do not need to be explained.) For example:

1. Explain what shading by adjacent buildings has been included in the analysis and how it has been modeled (e.g. either using the program capabilities or as a north-facing wall, etc.).
2. If there are below-grade walls and floors, explain how the heat loss has been modeled for these (e.g. either as an exterior wall with a limited ground temperature variation or as a constant negative load to a zone, etc.)
3. If a program cannot model a system exactly, explain why the modeling assumptions used are the best representation of that system.

It is intended that the material in this section provide a heads-up for anything unusual. Again, it is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

IV. Discussion of Estimated Energy Consumption Differences

The discussion of estimated energy consumption differences is a summary and an attempt at explanation of the energy savings.

1. First, list the total energy consumption on a BTU-per-conditioned-square-foot-per-year basis for both the Standard Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Design (i.e. what the energy efficiency improvement has been).
2. Then, review the energy savings by end use, starting with the end use which has the largest difference as a percent of the Standard Design total. Attempt to correlate the differences by end use with the strategies used. While some changes will have a simple, direct correlation with consumption, other end use differences may have a more complex explanation due to interactive effects. For example:
   - Changes in exterior lighting will have a simple, direct correlation with consumption.
   - Differences in space heating and space cooling are likely due to a combination of building envelope and HVAC system strategies. (Lacking any better information, the following procedure can provide a rough-cut disaggregation. First, determine the ratio of the design heating load of the Proposed Design to the design heating load of the Standard Design. Multiply the space heating energy consumption of the Standard Design by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope had changed. This difference is what could be attributed to the building envelope. Second, determine the ratio of the average equipment efficiency of the Proposed Design to the average equipment efficiency of the Standard Design. Multiply the space heating energy consumption from the first step by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope and equipment efficiency had changed. This second difference is what could be attributed to changes

in equipment efficiency. Finally, assume that whatever energy consumption differences remain are due to other HVAC system strategies. Follow this same process for space cooling, starting with a comparison of loads, then equipment efficiency, then system type. Differences in economizer cycle, however, add another layer of complexity.)

It is intended that this section be, at a minimum, a back-of-the-envelope check that the results of the analysis are reasonable.

Appendices (Supporting Materials)

A. Energy Analysis Summary Form (required)
   1. Complete the Energy Consumption by End use portion of the form for each project. Where a project has multiple buildings which are individually analyzed, complete the form for each building as well as for the overall project. (An automated electronic spreadsheet version of this page is on the DPD Seattle Energy Code website at: www.seattle.gov/dpd/energy.)
   2. Complete the Design Parameter Comparison portion of the form for each project. Where a project has multiple HVAC systems, complete the HVAC information for each system. (An electronic version of these pages is on the DPD Seattle Energy Code website at: www.seattle.gov/dpd/energy.)

B. General Information
   1. Site Plan (required) – provide site plan (8½ x 11 preferred) showing location and height, in feet or stories, of all adjacent buildings and also any other buildings and topography which would provide significant shading of the proposed building.
   2. HVAC zoning diagram used in the modeling process (required) – provide zoning diagram indicating zone lines and with zones labeled to match the modeling. (Providing takeoff sheets with area inputs will simplify review.)

C. Building Envelope
   1. Glazing and opaque doors, including windows, skylights, sliding/swinging/rollup doors, glass block (required):
      a. for U-factor,
         i. provide NFRC Certification Authorization Report (CAR) from NFRC-licensed Inspection Agency for the overall fenestration product including the frame OR
         ii. copy of simulation by NFRC-accredited simulation laboratory for the overall fenestration product including the frame OR
         iii. manufacturer's specifications where default U-factors from Chapter 10 have been used;
      b. for Solar Heat Gain Coefficient (SHGC),
         i. provide NFRC Certification Authorization Report (CAR) from NFRC-licensed Inspection Agency for the overall fenestration product including the frame OR
         ii. copy of simulation by NFRC-accredited simulation laboratory for the overall fenestration product including the frame OR
         iii. manufacturer's specifications where shading coefficient of the glass alone has been used.

(Note products claiming NFRC values must be labeled. For site-assembled products, the NFRC Label Certificate must be on job site prior to installation of first fenestration product. See CAM 403 for more information.)

2. Opaque roof, wall, floor (required):
   a. provide cross-sections and U-factor calculations for each different assembly where default U-factors from Chapter 10 have not been used;
   b. if multiple elements (e.g.. three wall types) are combined into one value for modeling purposes, provide calculations used to determine weighted-average value.
3. Shading diagrams (required):
   a. provide information on how shading by adjacent buildings and topography has been modeled,
   b. provide wall and roof sections showing overhangs and setbacks for glazing to justify the shading modeled.

D. Lighting
   1. Interior lighting (as applicable):
      a. explain any special assumptions about interior lighting,
      b. discuss lighting inputs to account for any exempt lighting (e.g. retail, kitchen).
   2. Parking/outdoor areas lighting (as applicable):
      a. provide calculation of areas for parking garages, then multiply by 0.20 Watts/square foot; provide calculation of areas for surface parking, and other lighted outdoor areas, then multiply by 0.15 Watts/square foot to obtain Standard Design;
      b. provide supporting information for Proposed only if different from Standard Design;
      c. if program does not list parking/outdoor area lighting energy consumption separately, then provide calculation of annual energy consumption for this end use.
   3. Façade lighting (required):
      a. provide calculation of building façade, then multiply by 0.15 Watts/square foot to obtain Standard Design;
      b. provide supporting information for Proposed only if different from Standard Design;
      c. if program does not list facade lighting energy consumption separately, then provide calculation of annual energy consumption for this end use.

E. Space Heating and Space Cooling Equipment and Plant
   1. provide manufacturer's specifications for equipment efficiency,
   2. provide calculations per ARI standards for COP, EER, IPLV,
   3. provide list of equipment and size and calculations to justify if Proposed Design includes multiple pieces of equipment and a weighted average equipment efficiency is used in the energy analysis,
   4. provide calculations to justify the equipment size for the Standard Design
      a. provide calculations of ratio of Proposed Design equipment size to Proposed Design design heating load and design cooling load,
      b. provide calculations of ratio of Standard Design equipment size to Standard Design design heating load and design cooling load.

F. Ventilation - interior (required):
   1. provide W/CFM calculations for the ventilation system for the Proposed Design and for the Standard Design to justify inputs for the Standard Design,
   2. if program does not list energy consumption for interior ventilation separately in the output, then provide calculation of annual energy consumption for this end use.

G. Interior Exhaust Fans (as applicable):
   1. where multiple toilet exhaust and relief fans are to be installed, provide listing of capacity for each and total for the interior exhaust fans,
   2. if program does not list energy consumption for interior exhaust fans separately in the output, then provide calculation of annual energy consumption for this end use.

H. Parking Garage Fans (as applicable):
   1. where multiple parking garage fans are to be installed, provide listing of capacity for each and total for the parking garage fans,
   2. if program does not list energy consumption for parking garage fans separately in the output, then provide calculation of annual energy consumption for this end use.

I. Service Water Heating (required):
   1. provide calculations used to size equipment (see RS-29 Table 3-1 for default assumptions for service hot water quantities in Btuh per person),
   2. if program does not list energy consumption for service water heating separately in the output, then provide calculation of annual energy consumption for this end use.

J. Other End uses
   1. Office/miscellaneous equipment (as applicable):
      a. if program requires an input of total equipment capacity rather than capacity on a square foot basis, then provide calculations used to size equipment (see RS-29 Table 3-1 for default assumptions for service hot water quantities in Watts/square foot),
      b. if program does not list energy consumption for office/miscellaneous equipment separately in the output, then provide calculation of annual energy consumption for this end use.
   2. Elevators and escalators (as applicable):
      a. where multiple elevators and escalators are to be installed, provide listing of capacity for each and total for the system,
      b. if program does not list energy consumption for elevators and escalators separately in the output, then provide calculation of annual energy consumption for this end use.
   3. Refrigeration - food, etc. (as applicable):
      a. where multiple units are to be installed for refrigeration other than for comfort cooling, provide listing of capacity for each and total for the system,
      b. if program does not list energy consumption for refrigeration other than for comfort cooling separately in the output, then provide calculation of annual energy consumption for this end use.
   4. Cooking (as applicable):
      a. where multiple units are to be installed for cooking, provide listing of capacity for each and total for the system,
      b. if program does not list energy consumption for cooking separately in the output, then provide calculation of annual energy consumption for this end use.
   5. Other (as applicable):
      a. provide supporting data for other end uses (e.g. commercial washers and dryers, etc.),
      b. if program does not list energy consumption for other end uses separately in the output, then provide calculation of annual energy consumption for these end uses.

K. Computer Printout of Inputs and Outputs
   Provide inputs and outputs <u>with pages numbered</u> so cross-references can be made to the Energy Analysis Summary Form.

ENERGY ANALYSIS SUMMARY FORM

PROJECT INFORMATION

DPD Project Address: _____ DPD Project Number: _____

Project Name: _____ Date of this submittal: _____

	Conditioned Space						Unconditioned Space			
Building Uses:	Office	Retail	Group R	_____	_____	Subtotal	Parking	_____	Subtotal	Total
Area (sq.ft.):	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

ENERGY CONSUMPTION BY END USE

		STANDARD DESIGN			PROPOSED DESIGN			DIFFERENCES		
END USE	FUEL SOURCE	Total Energy Use Estimate	BTU/ Cond. Sq.Ft.-Year	% of Standard Design Total	Total Energy Use Estimate	BTU/ Cond. Sq.Ft.-Year	% of Proposed Design Total	Total Energy Use Estimate	BTU/ Cond. Sq.Ft.-Year	% of Standard Design Total
Lighting - interior		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Lighting - parking		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Lighting - façade		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Space Heating (1)		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Space Heating (2)		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Space Cooling		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Fans - interior ventilation		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Fans - interior exhaust		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Fans - parking garage		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Service water heating		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Office equipment		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Elevators & escalators		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Refrigeration (food, etc.)		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Cooking (commercial)		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
_____		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
_____		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
_____		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
_____		_____	_____	_____%	_____	_____	_____%	_____	_____	_____%
Total		_____	_____	100.0%	_____	_____	100.0%	_____	_____	

Percent of Standard Design: 100.0% % = _____ % + _____ %

INSTRUCTIONS:

Electronic Version:
A spreadsheet version is available on the Seattle Energy Code website @ www.seattle.gov/dpd/energy

Project Information:
Enter DPD address, project number, and date of this Energy End Use Summary Form.
Enter the space uses in the building and the gross square footage of each.
(Add/revise headings as necessary.) Spreadsheet automatically calculates subtotals and total.

Energy Consumption by End Use:
Enter fuel source for each end use (e.g. electric, gas, oil, steam, etc.).
Enter total energy consumption in **BTU** for each end use for both the Standard Design and Proposed Design.
(Spreadsheet calculates the BTU/conditioned-square-foot-year, percentages, and differences.)

DESIGN PARAMETER COMPARISON

Element	Standard Design Value	(Page)	Proposed Design Value	(Page)
Building Envelope				
Space heat type (electric resistance vs. other):				
Glazing: total vertical + overhead area (sq. feet):				
Glazing area as a percentage of gross wall (%):				
Overhead: total area (square feet):				
Overhead U-factor (weighted-average):				
Overhead SHGC (weighted-average):				
Vertical: total area (square feet):				
Vertical U-factor (weighted-average):				
Vertical SHGC (weighted-average):				
Roof: total area (square feet):				
Opaque roof: net area (square feet):				
Opaque roof U-factor (weighted-average):				
Wall: total above-grade area (square feet):				
Opaque above-grade wall: net area (square feet):				
Above-grade wall U-factor (weighted-average):				
Below-grade wall: net area (square feet):				
Below-grade wall U-factor (weighted-average):				
Opaque door: area (sq. feet):				
Opaque door U-factor (weighted-average):				
Floor over unconditioned space: area (sq. feet):				
Floor U-factor (weighted-average):				
Slab-on-grade floor: perimeter (lineal feet):				
Slab-on-grade F-factor (weighted-average):				
Below-grade slab floor: net area (square feet):				
Below-grade floor U-factor (weighted-average):				
Infiltration rate:				
Design heating load:				
Design cooling load:				
Lighting				
Interior				
Watts/sq.ft.: Office				
Watts/sq.ft.: Retail				
Watts/sq.ft.:				
Watts/sq.ft.:				
Parking/outdoor: total area (square feet)				
Watts/square foot				
Façade: total area (square feet)				
Watts/square foot				

DESIGN PARAMETER COMPARISON (cont.)

Element	Standard Design Value	(Page)	Proposed Design Value	(Page)
Space Heating and Space Cooling System				
Space Heating: system type:				
Peak equipment efficiency:				
Output capacity:				
Percent of design heating load:				
Other features:				
Space Cooling: system type:				
Peak equipment efficiency:				
Output capacity:				
Percent of design cooling load:				
Other features:				
Ventilation				
Interior ventilation fans				
Economizer type (air or water):				
Economizer percentage:				
Supply fan: total CFM:				
Fan KW:				
Return fan: total CFM:				
Fan KW:				
Exhaust fan: total CFM:				
Fan KW:				
System Watts/CFM:				
Other features:				
Other features:				
Service Water Heating				
Capacity:				
Other End uses				
Fans – toilet and other exhaust: capacity (KW)				
Fans – parking garage: capacity (KW)				
Elevator and escalator: capacity				
Refrigeration: capacity				
Cooking: capacity				
_____: capacity				
_____: capacity				
_____: capacity				